

DARE MIGHTY THINGS

“Why Do We Explore (Deep Space)”

2017 CAWG Aerospace Education Summer Camp

August 4, 2017

David Oberhettinger, Chief Knowledge Officer (CKO)

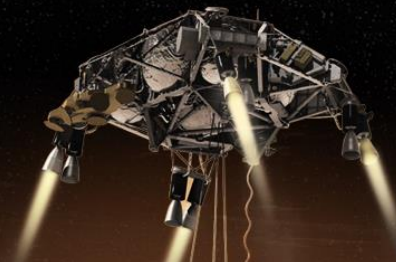
NASA/Caltech Jet Propulsion Laboratory (JPL)



DARE MIGHTY THINGS

50TH ANNIVERSARY OF PLANETARY EXPLORATION

2013



Jet Propulsion Laboratory
California Institute of Technology



visit the JPL website >



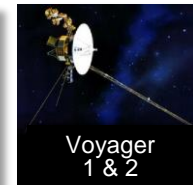
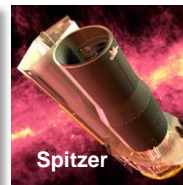
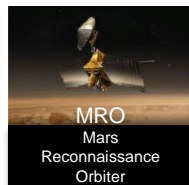
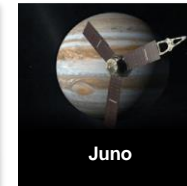
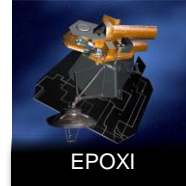
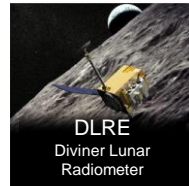
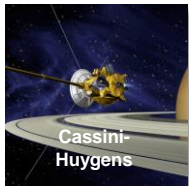
**your speaker, and the
Mars rover family →**



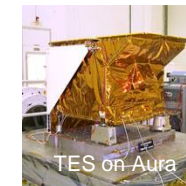
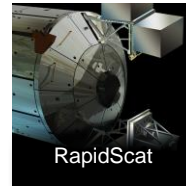
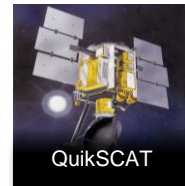
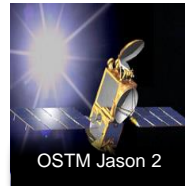
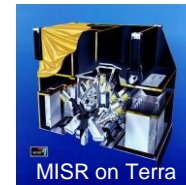
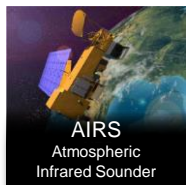


Current JPL Spaceflight Projects

Deep Space Missions



Earth Orbiting Missions





JPL Spaceflight Projects in Development

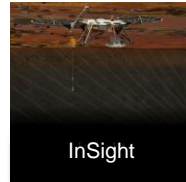
Deep Space Missions



ARRM
Asteroid Redirect
Robotic Mission



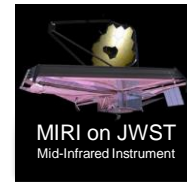
Europa



InSight



Mars 2020



MIRI on JWST
Mid-Infrared Instrument



Psyche



OSIRIS-REx



RIME
Radar for Icy
Moon Exploration

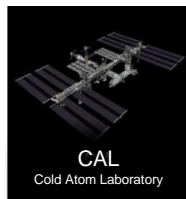


**ST7 on
LISA**



TGO Electra

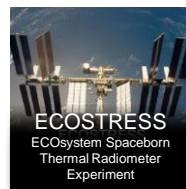
Earth Orbiting Missions



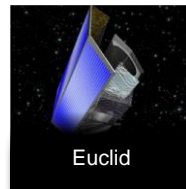
CAL
Cold Atom Laboratory



COWVR
Compact Ocean Wind
Vector Radiometer



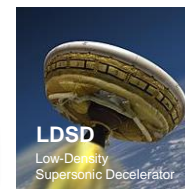
ECOSTRESS
ECOSystem Spaceborn
Thermal Radiometer
Experiment



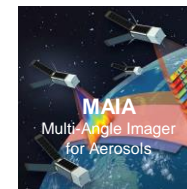
Euclid



GRACE-FO
Gravity Recovery and
Climate Experiment
Follow-On



LDSD
Low-Density
Supersonic Decelerator



MAIA
Multi-Angle Imager
for Aerosols



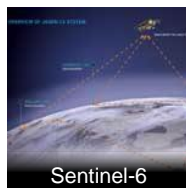
NISAR
NASA-ISRO Synthetic
Aperture Radar



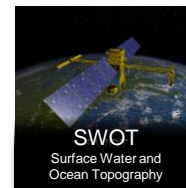
OCO-3
Orbiting Carbon
Observatory



RBI
Radiation Budget
Instrument



Sentinel-6



SWOT
Surface Water and
Ocean Topography



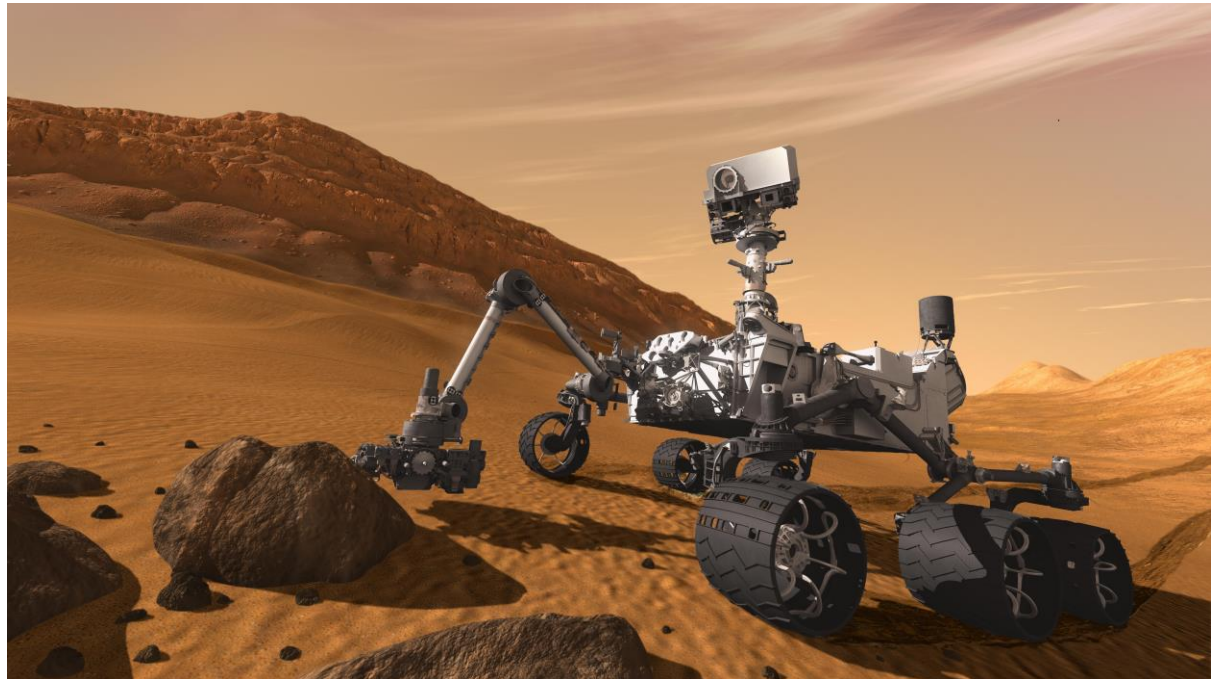
WFIRST
Wide Field Infrared
Survey Telescope

Pre-Decisional Information -- For Planning and Discussion Purposes Only

Mars Science Laboratory (MSL) “Curiosity” Rover

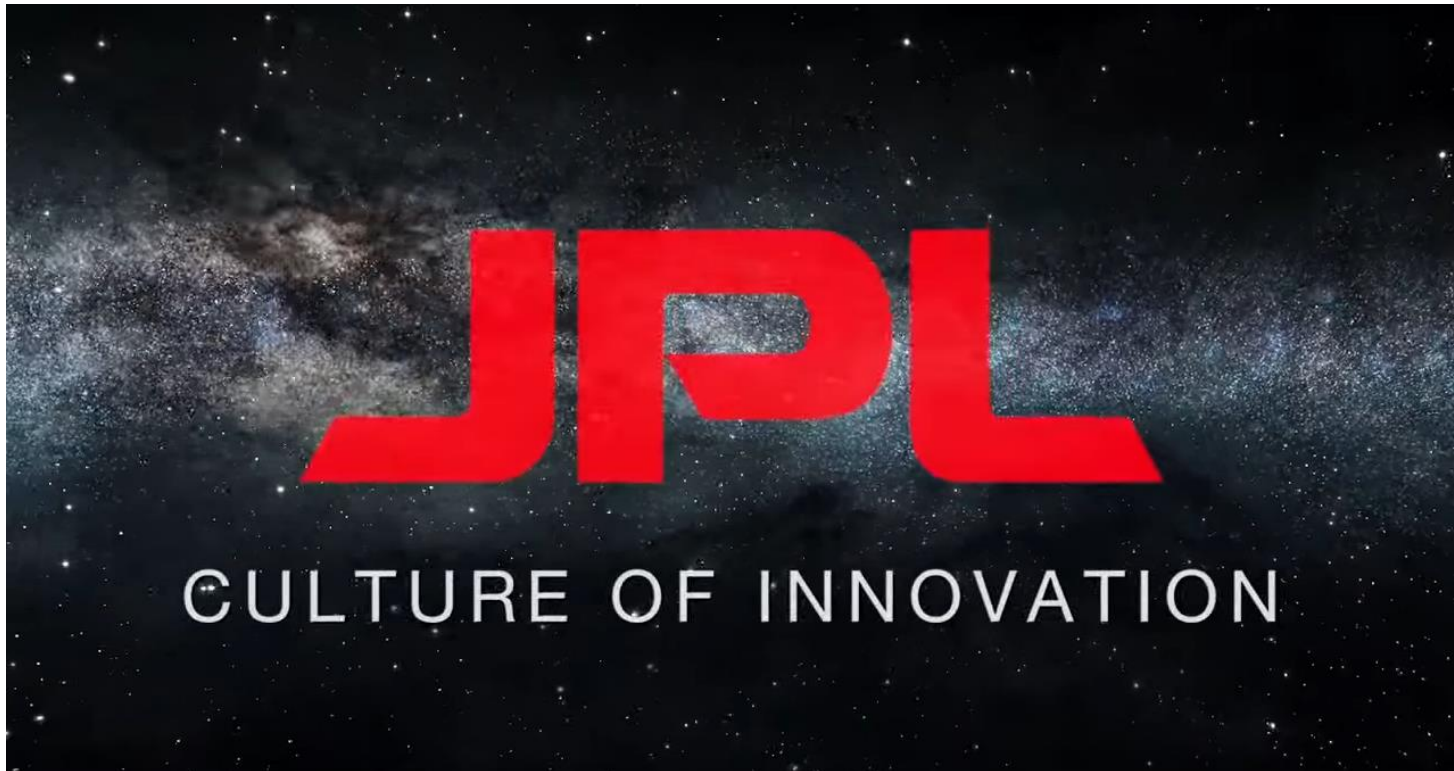


- Has operated on Mars for 5 years
- The size and mass of a Mini Cooper
- Radioisotope-powered
- Learning more about Mars' past and Earth's possible future





JPL “Culture of Innovation”



<https://www.youtube.com/watch?v=RFrGkSyxTgl>



What are the stakes in space exploration?

- We turn to space for answers about the possibility of extraterrestrial life, origins of the universe, and even for clues on how we can better protect our own planet
- Science return: learning about our neighborhood, and
- Maybe it is worthwhile doing something just because it's difficult



The Great Pyramids of Giza

Four Business Cases

- Examples of potentially high stakes involved in space exploration



2



1



3



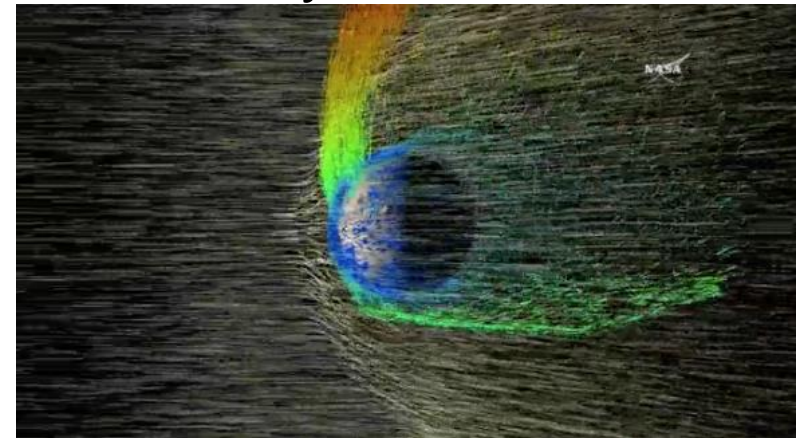
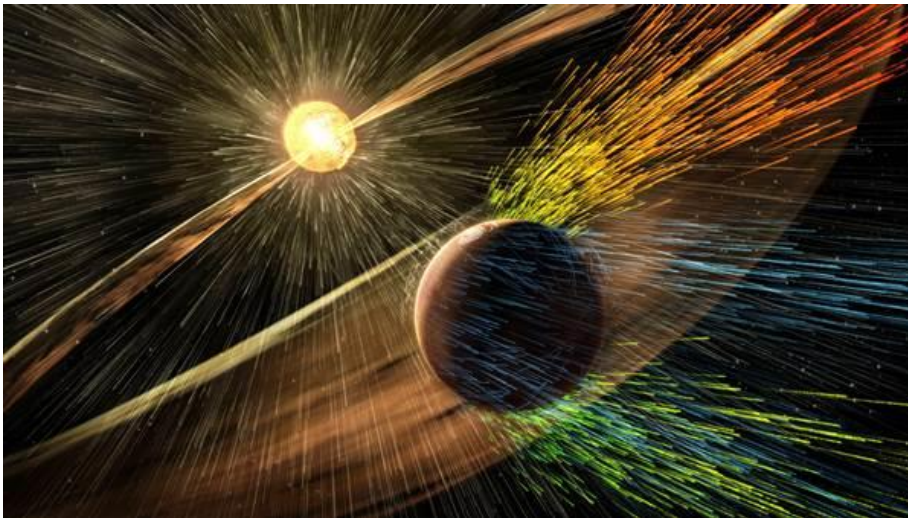
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High Stakes
Business Case #1:

Goodbye Earth's Atmosphere

- Mars Atmosphere and Volatile Evolution (MAVEN)
- Objective: Explain the loss of volatile compounds from the Martian atmosphere to space.
- Result: data from a March 2015 solar mass ejection

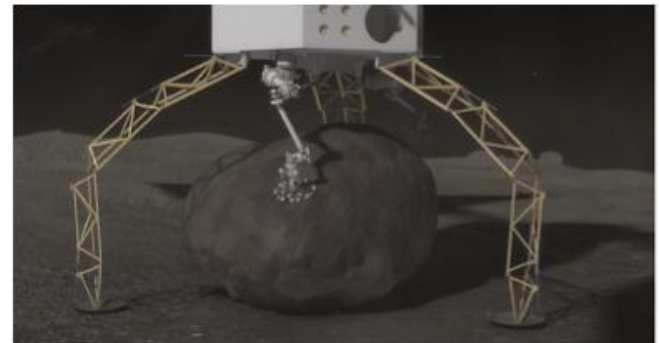
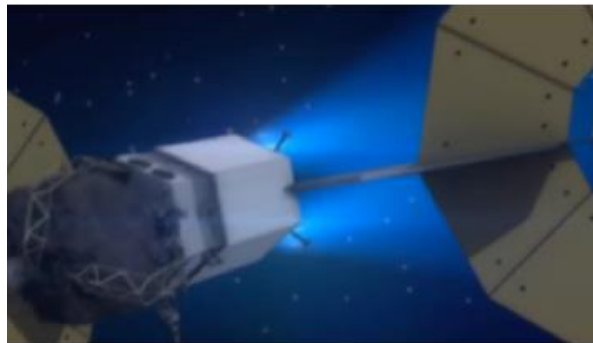
show loss of Mars' atmosphere continuing even today





High Stakes
Business Case #2:
Planetary Defense

- **JPL proposed Asteroid Redirect Robotic Mission (ARRM).** JPL planned to rendezvous with an asteroid, grab it or a piece of one, and tow it into near-Earth orbit



- ARRM included a “gravity tractor” demo— a possible technique for diverting a hazardous Earth-bound asteroid



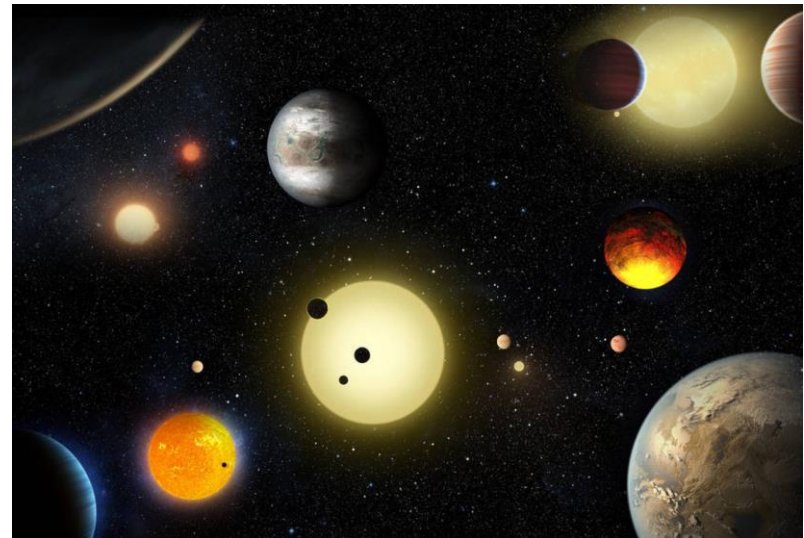


High Stakes
Business Case #3:
Other Earths

- **JPL Kepler Mission.** The spacefaring observatory has discovered 50 planets like Earth (i.e., Earth size and located in the “habitable zone”) orbiting distant stars



- Are we alone?



High Stakes
Business Case #4:
Return on Investment





Cool JPL Apps

<http://www.jpl.nasa.gov/apps/>



Eyes on the Earth

View recent data of Earth's vit
how they collect critical data a
and see spectacular views of



Eyes on the Solar System

Explore the cosmos from your comp
real NASA mission data. Hop on an
spacecraft. See the entire solar syst



Eyes on Exoplanets

This desktop app and visuali
simulation, populated from re
been discovered around othe



Deep Space Network Now

To keep in contact with the spacecra
universe beyond, JPL operates a net
the DSN. This online app will let you



Space Images

Discover, share and
NASA's Jet Propulsi
Touch, iPad and Ani



Spacecraft 3D

Get an up-close-and
designed to study th
reality application.



Apollo 8: Earthrise

First photo of Earth from the Moon





Dare Mighty Things

“Far better is it to **dare mighty things**, to win glorious triumphs, even though checked by failure...than to rank with those poor spirits who neither enjoy much nor suffer much, because they live in a gray twilight that knows not victory nor defeat.”

- Theodore Roosevelt, 26th
President of the United States